



PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPLICANT: HENNHÖFER ET AL.
SERIAL NO.: 09/032,305 EXAMINER: R. KUNEMUND
FILED: FEBRUARY 27, 1998 GROUP: 1765
TITLE: PROCESS FOR TREATING A POLISHED SEMICONDUCTOR
WAFER IMMEDIATELY AFTER THE SEMICONDUCTOR WAFER
HAS BEEN POLISHED

BRIEF ON APPEAL

MAIL STOP APPEAL BRIEF PATENTS
Commissioner for Patents
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Dear Sir:

This is in response to the Final Office Action dated December 4, 2002, with the time for reply having been extended for three months, from MARCH 4, 2003, until JUNE 4, 2003, and with a Notice of Appeal and the Appeal Fee having been filed and paid in a timely manner on JUNE 4, 2003. A Petition for a two month Extension of Time, and the required Extension Fee, have been filed concurrently herewith to extend the due date from AUGUST 4, 2003, until OCTOBER 4, 2003, to file this Brief On Appeal.

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In accordance with the provisions of U.S.P.T.O. Rule 192(c), the following 9 items under the appropriate headings are now provided:

(1) REAL PARTY IN INTEREST

The real party in interest, is the party named in the caption of the Brief On Appeal.

(2) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to appellant, the appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) STATUS OF CLAIMS

A Statement of the status of all the claims is as follows. Claims 1 to 5 and 8 have been cancelled. Claims 6, 7 and 9 to 20 are now pending and are on appeal.

(4) STATUS OF AMENDMENTS

The status of any Amendment or Response previously filed is that each document has been entered.

(5) SUMMARY OF INVENTION

An explanation of the invention defined in the claims involved in the appeal, is as follows.

The present invention relates to a process for treating a polished semiconductor wafer immediately after the semiconductor wafer has been polished. (Please see Specification at page 1 first paragraph).

In the prior art, it is known that polishing the semiconductor wafer represents the final step in the production of the semiconductor wafer and has a decisive influence on the shaping of the semiconductor wafer. The object of the polishing is to create a surface which is as planar, smooth and defect-free as possible on at least one of the two sides of the semiconductor wafer. Such a surface is absolutely imperative if it is to be possible to accommodate functioning electronic structures in high density on the semiconductor wafer. Certain defects on the surface of the semiconductor wafer may later lead to an electronic component failing. These defects can be recognized by a characteristic light scattering behavior and can be indicated in terms of size and number as so-called LPDs (light point defects).

(Please see Specification on page 1, second paragraph).

The polished surface of the semiconductor wafer has hydrophobic properties. It is very sensitive to uncontrolled chemical attack from an etching agent and it promotes the deposition of particles. Both of these problems can lead to a relatively rapid increase in the number of LPDs. Such an increase in LPD can be avoided by ensuring that the environment is as free of particles as possible. Also the uncontrolled chemical attack from residues of polishing abrasive is suppressed by transferring the semiconductor wafer into a flushing bath or a cleaning bath immediately after the polishing. (Please see Specification at page 2, second paragraph).

It is an object of the present invention to provide a process for counteracting the considerable increase in the number of LPDs occurring when a polished semiconductor wafer is not cleaned immediately after the polishing, but rather is stored before it is later cleaned. (Please see Specification, at page 3, second paragraph).

The present invention is directed to a process for treating a polished semiconductor wafer comprising polishing a surface of a semiconductor wafer; and immediately after polishing the semiconductor wafer, bringing the semiconductor wafer into contact with an aqueous treatment agent solution for oxidizing the polished surface by action of the aqueous treatment agent

solution. (Please see paragraph bridging pages 3 to 4 of Specification).

The polished surface of the semiconductor wafer is then coated with a thin film of oxide and has hydrophilic properties. As a result, the semiconductor wafer is less sensitive to residues of polishing abrasive and to particles. After the oxidizing treatment, it can be stored and cleaned in the usual way only at a later time without the risk of having the number of LPDs increase considerably during the storage time. (Please see Specification at page 4, first complete paragraph).

The semiconductor wafer can be brought into contact with the treatment agent in various ways. This contact can take place while the semiconductor wafer is still lying on the polishing plate. On the other hand, the semiconductor wafer may also first be removed from the polishing plate and then transferred to a different substrate or into a holder. Accordingly, the oxidizing treatment takes place in the polishing machine or in an unloading station which is connected thereto. (Please see Specification at page 5 last paragraph).

(6) ISSUES

A concise statement of the one issue presented for review is as follows. The one issue is whether, or not, the rejection of claims 6, 7, and 9 to 20 under 35 U.S.C, 103(a) as being unpatentable over *Fabry et al* in view of *Hayashida et al* and *Lampert et al*, should be reversed.

(7) GROUPING OF CLAIMS

All of the claims, on appeal, stand or fall together.

(8) ARGUMENT

In the Final Office Action, dated December 4, 2002, the Patent Examiner has rejected claims 6, 7, and 9-20 under 35 U.S.C. 103(a) as being unpatentable over *Fabry et al* in view of *Hayashida et al* and *Lampert et al*.

The present invention is directed to a process for treating a semiconductor wafer, comprising polishing the semiconductor wafer; immediately after polishing the semiconductor wafer removing the semiconductor wafer from the polishing plate; immediately after removing the semiconductor wafer from the polishing plate, bringing the semiconductor wafer into contact with an aqueous treatment agent solution for oxidizing a polished surface of the semiconductor wafer by action of the aqueous treatment agent solution, the wafer being brought into contact

with the aqueous treatment agent solution in a manner which is selected from the group consisting of (a) spraying the semiconductor wafer with the aqueous treatment agent solution, (b) dipping the semiconductor wafer into the aqueous treatment agent solution and (c) applying the aqueous treatment agent solution to the polished surface of the semiconductor wafer by means of a cloth which has been moistened with the aqueous treatment agent solution; and cleaning the semiconductor wafer.

The Patent Examiner acknowledges on Page 2 of this Final Office Action that a difference between *Fabry et al.* and the claimed invention concerns the timing of the process steps. (Please see Final Office Action dated December 4, 2002.)

The *Fabry U.S. Patent* in column 5 in Example 1 in lines 59 to 63 discloses that subsequent to the polishing step, the wafers were first freed of polishing residues, and then subjected to an oxidative cleaning. Thus, there is an additional step of freeing from polishing residues in *Fabry*, and not the claimed step of immediately oxidizing after removing the wafers from the polishing plate.

The *Hayashida U.S. Patent* has no teaching and no disclosure of when wafer oxidizing occurs relative to wafer polishing.

As has been previously stated, there is a very important difference over the prior art references, namely the beginning of the oxidizing treatment which is the crucial difference between the claimed invention and the cited prior art.

According to the Patent Examiner, *Lampert et al* already teach that the steps of the process are to be done as soon as possible (Please see page 3, first sentence of the Final Office Action). It is respectfully submitted that this interpretation of the *Lampert* document is not supported by the actual disclosure of *Lampert*. The Patent Examiner also failed to indicate where such a teaching can be found in the *Lampert* patent.

If the *Lampert* reference is systematically read in order to discover this teaching relating to the starting time for the oxidizing treatment, several text passages will be found:

"The process can be achieved in a particularly simple manner generally by adding an oxidizing agent or oxidizing agent mixture, at the end of the polishing step, to the alkaline polishing agent flowing onto the workpiece surface." (Please see column 1, lines 60 - 65 of *Lampert*).

This is a clear statement in *Lampert* which does not leave any room for an interpretation of the above-mentioned kind. This statement sets the starting time for the oxidizing treatment at a moment when the wafers are still lying on the polishing plate. Hence, the starting time which is taught by *Lampert et al.* is earlier than the time claimed by the present invention. The inventor, Mr. Hennhöfer also showed in the filed Declaration Under Rule 132 the significant disadvantages which are inherent in the *Lampert et al.* process.

"In the process according to the present invention, the high quality of the polished surface, achieved in the course of the polishing step may by means of the coating applied directly on completion of the polishing step, be preserved in both one-side and two-side polishing of the silicon wafers." (Please see column 3, lines 27 - 32 of *Lampert*).

A proper interpretation of the meaning of "directly on completion" cannot be made without considering the rest of the *Lampert* disclosure, especially the passage in column 1 lines 60 - 65, noted above and further in Example 2 and in claim 1:

"Without interrupting the polishing operation, polishing was continued for another minute with continued feed of the now-peroxide-containing polishing agent under otherwise unchanged

conditions.." (Please see Example 2, column 4, lines 39-42 of *Lampert*.)

"...without interruption of the polishing, continuing and completing the polishing operation under oxidizing conditions..." (Please see column 5, lines 4 to 7 of claim 1 of *Lampert*).

After considering all of these quotations, it must be concluded that the whole document provides no proper basis for the Patent Examiner's assertion that *Lampert et al* already teach that the steps of the process are to be done as soon as possible. In fact, it is evident that *Lampert et al* teach the oxidizing of the wafers at a time when the wafers are still lying on the polishing plate.

However, based upon this teaching in *Lampert*, then it would be impossible to combine *Fabry et al.* with *Lampert et al.* so that the claimed invention would have resulted. This is because *Fabry* teaches as a precise starting time for oxidation, a time which is set after the polishing wafers have been freed from polishing residues. Please see column 5 lines 59 to 67 in Example 1 of *Fabry*).

Thus there exists, this substantial inconsistency in the teachings of these prior art references. This situation is as follows: *Fabry et al.* teach a starting time which is later than the time specified in the claimed invention, while *Lampert et al.* teach a time which is earlier than the time claimed in the present invention. Accordingly, one who is skilled in the art would have to choose between the teaching of either *Fabry et al.* or *Lampert et al.* However, one skilled in the art could not choose both teachings which are mutually exclusive and exclude each other and which are entirely different from the presently claimed invention.

In the Advisory Action dated JUNE 18, 2003, the Patent Examiner, made the following two contentions.

The first contention is that the Applicants' argument concerning the *Fabry et al* reference is noted. However, the reference is not limited in scope to one example. There is no other teaching found in the reference to indicate that a cleaning step is necessary. It is pointed out that the reference does however, teach that the polishing step is to be done as soon as possible to prevent contamination after polishing steps.

The second contention is that the Applicant's argument concerning the *Lampert et al* reference has been considered and not deemed persuasive. The *Lampert* reference in column one describes a problem with a wafer, which is not oxidized in a speedy manner. The reference further teaches that polishing followed quickly by oxidization overcomes this problem. Thus, the reference does teach one of ordinary skill in the art to oxidize in the manner, which is claimed.

These contentions are respectfully traversed.

In answer to the first contention of the Patent Examiner, the *Fabry* reference in Example 1 in column 5 in lines 59 to 63 teaches that the silicon wafers were first freed of polishing residues and then subjected to an oxidative cleaning procedure. Examples 2 and 3 of *Fabry* in columns 7 and 8 do not contradict this teaching in Example 1 of *Fabry*.

The statement in the Advisory Action that there is no other teaching found in *Fabry* to indicate that a cleaning step is necessary is respectfully traversed. This is because there is no teaching in *Fabry* that a cleaning step can be omitted. Furthermore, only one teaching in *Fabry* is required to indicate that a cleaning step is necessary.

The Patent Examiner further alleges that *Fabry* does teach that the polishing step is to be done as soon as possible to prevent contamination after polishing steps. Presumably the Patent Examiner is referring to *Fabry* in column 2 in lines 57 to 68, and specifically in column 2 in lines 64 to 68. Here *Fabry* discloses that "expediently, the wafers are subjected to this exposure as promptly as possible subsequent to the oxidative treatment, although, according to experience, waiting times of up to about 12 hours have been found to be still tolerable."

The fact that "waiting times of up to 12 hours have been found to be still tolerable" strongly indicates that there is no urgency to carry out this "exposure" as promptly as possible. The "exposure" referred to in *Fabry* is the side reaction with the organosilicon compounds of *Fabry*. This teaches away from the claimed invention.

A more relevant teaching in *Fabry* is found in column 5 in lines 59 to 63 wherein the polished silicon wafers, were first freed of polishing residues and then subjected to an oxidative cleaning. Thus *Fabry* teaches away from the claimed oxidizing treatment immediately after polishing as recited in the present invention. *Fabry* requires inserting an intermediate step between polishing and oxidizing treatment, which intermediate step is the freeing of the wafer surface of polishing residues.

In the Advisory Action of June 18, 2003, the Patent Examiner stated a second contention that the *Lampert* reference in column one describes the problem with wafers which are not oxidized in a speedy manner. The *Lampert* reference further teaches that polishing followed quickly by oxidization overcomes this problem. Thus, the *Lampert* reference does teach to one of ordinary skill in the art to oxidize in the manner, which is claimed.

These statements in the second contention of the Patent Examiner are respectfully traversed for the following reasons.

Lampert does not teach a separate wafer oxidizing step immediately after a prior wafer polishing step carried out sequentially, as is claimed. Instead *Lampert* teaches a simultaneous step of polishing with oxidizing together in one step.

This can be seen from *Lampert* in column 1 in lines 60 to 65 which discloses adding an oxidizing agent or oxidizing agent mixture, at the end of the polishing step, to the alkaline polishing agent flowing onto the workpiece surface. This teaches the simultaneous step of polishing with oxidizing, together in one step.

Lampert in column 2 in lines 21 to 25 discloses that "after adding the oxidizing component to the polishing agent, it is generally sufficient to continue the polishing step for a brief period under otherwise unchanged conditions, for example, for from 0.5 to 5 minutes, preferably for from one to two minutes." This teaches the simultaneous step of polishing with oxidizing, together in one step.

Further teachings in Lampert directed to the simultaneous step of polishing together with oxidizing in one step can be found in Example 2 in column 4 in lines 27 to 42, as follows:

"Eight silicon wafers (diameter = 125 mm, (100) - orientation) were polished under the equal polishing conditions (polishing pressure about 0.5 bar; temperature about 50° C.) in a polishing machine for the 2-side polishing of silicon wafers. First, during the 20 minute polishing operation, a commercial alkaline polishing agent based on silica sol was pumped onto the polishing cloth from a supply vessel. Thereafter, a 30% solution of hydrogen peroxide was added to the polishing agent contained in the supply vessel, until the polishing agent had a concentration of 1% peroxide by volume."

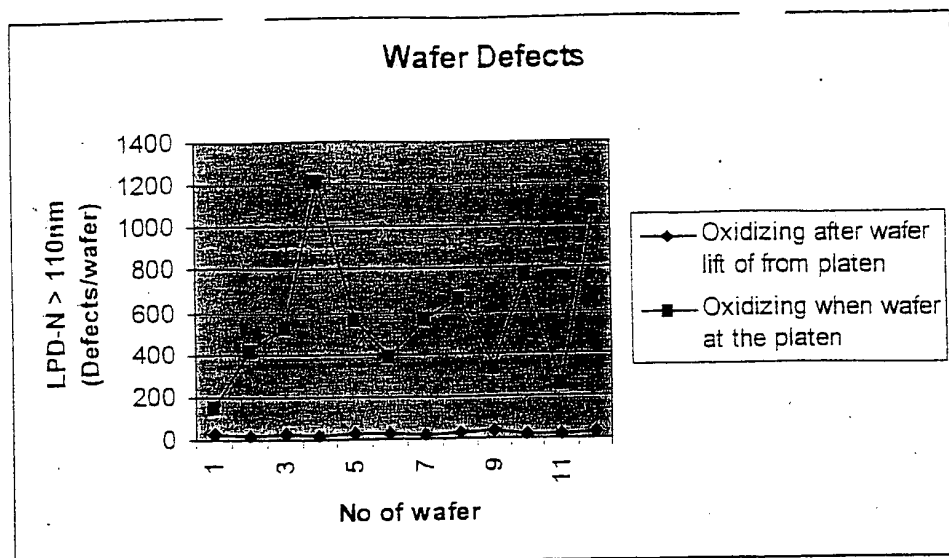
"Without interrupting the polishing operation, polishing was continued for another minute with continued feed of the now-peroxide-containing polishing agent under otherwise unchanged conditions." Thus Lampert teaches the simultaneous step of polishing with oxidizing, together in one step. Hence, Lampert fails to teach a separate wafer oxidizing step immediately after a prior wafer polishing step carried out sequentially as is claimed.

In the Hennhöfer Declaration Under Rule 132, previously filed on September 18, 2002, a Comparative Testing Program was conducted with the Lampert reference and the present invention.

According to the Hennhöfer Declaration, the Patent Examiner correctly states in the recent Office Action that the timing of the process steps is one of the crucial points which delimits the present invention from the cited prior art.

According to the present invention it is crucial to bring a polished semiconductor wafer into contact with an oxidizing agent right after having removed the wafer from a polishing plate. Any procedure which differs from this sequence is going to have serious drawbacks.

In this Declaration, there is a diagram containing the Comparative Testing results.



Based on this diagram, *Lampert et al.* intended to form an oxide film on the wafers by adding an oxidizing agent to the wafers while the wafers were still lying on the polishing platen (simultaneous polishing and oxidizing step). This is in order to stop the polishing process and to protect the wafer surface by the oxide film. However, this method is connected with the drawback that the forming oxide film will be partly destroyed by the mechanical action of the rotating polishing platen. This is because there are locations which are not protected by an oxide

film; hence semiconductor material is removed by the action of the polishing agent which is still present. This finally leads to defects which can afterwards be detected on the wafer surface as shown in the above diagram, as a direct result of the simultaneous polishing and oxidizing step of *Lampert*.

Moreover, if the oxidizing agent is supplied when the wafers are still lying on the polishing plate, the polishing of subsequent wafers is impaired unless the oxidizing agent is thoroughly removed from the polishing plate.

The Patent Examiner has stated in a previous Office Action that *Lampert et al.* would teach that the process steps were to be done as soon as possible. However, it is also disclosed that as soon as possible has to be interpreted as meaning as soon as possible while the wafers are still lying on the polishing platen. *Lampert et al.* teaches adding an oxidizing agent, at the end of the polishing step, to the alkaline polishing agent flowing onto the workpiece surface (See column 1, line 60 -64). According to both examples given at the end of this *Lampert* reference, the wafers are still in the polishing machine when the oxidizing agent is added, (i.e. - simultaneous polishing and oxidizing step).

Therefore, since *Lampert et al.* do not disclose removing the wafer from the polishing plate before the oxidizing treatment, this *Lampert* document clearly leads away from the present invention, which claims sequential polishing then oxidizing.

SUMMARY

The *Fabry* patent teaches that there is an intermediate step between the wafer polishing step and the wafer oxidizing step. This is because *Fabry* teaches that the polished wafers were first freed of polishing residues and then oxidatively cleaned. Because *Fabry* adds this intermediate step, there can be no immediately oxidizing of the polished wafer. *Fabry* requires the addition of this extra intermediate cleaning step, which teaches away from the immediate oxidizing step of the claimed invention.

Lampert teaches adding an oxidizing agent at the end of the polishing step to the polishing agent flowing onto the workpiece surface. Thus *Lampert* discloses the simultaneous polishing and oxidizing of the wafer in a single combined step. This was shown by the Hennhöfer Declaration to cause a significant increase in the number of undesirable LPD's on the wafer surface, brought about by the *Lampert* teaching. The *Lampert* disclosure teaches away from the claimed sequential steps of polishing the wafer followed by immediately oxidizing the wafer.

The Hayashida patent has no teaching as to when wafer oxidizing occurs relative to wafer polishing.

CONCLUSIONS

In view of all the reasons set forth above, all the claims must be considered as being non-obvious under 35 U.S.C. 103 with respect to the prior art applied by the Patent Examiner. Reversal of this ground of rejection is respectfully requested.

Respectfully submitted,

HEINRICH HENNHÖFER ET AL.

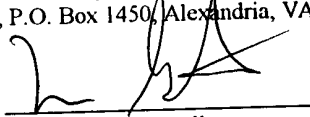
By: 

Allison C. Collard, Reg. No. 22,532
Edward R. Freedman, Reg. No. 26,048
Attorneys for Applicant

COLLARD & ROE, P.C.
1077 Northern Boulevard
Roslyn, NY 11576
(516) 365-9802
ERF:dm

Encl.: (1). Appendix (9)

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as first class mail in an envelope addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 2, 2003.



Maria Guastella

(9) APPENDIX

In this appendix is a copy of the claims involved in this appeal, which are claims 6, 7 and 9 to 20.

6. Process according to Claim 14, comprising
bringing the semiconductor wafer into contact with the
aqueous treatment agent solution in a polishing machine.

7. Process according to Claim 14, comprising
bringing the semiconductor wafer into contact with the
aqueous treatment agent solution in an unloading station of a
polishing machine.

9. The process as claimed in Claim 14,
wherein the aqueous treatment agent solution comprises an
aqueous solution of

(1) from 0.02% to 3.0% by volume, based upon the total
solution volume, of an oxidizing agent;

(2) from 0.01% to 2.0% by weight, based upon the total
solution weight, of an alkaline component; and

(3) the balance up to 100% by volume being water based upon the total solution volume, and the balance up to 100% by weight being water, which is based upon the total solution weight.

10. The process as claimed in Claim 14,

wherein the aqueous treatment agent is at a temperature range of from 18° C to 65° C.

11. The process as claimed in Claim 14,

wherein the oxidizing agent is hydrogen peroxide and the alkaline component is selected from the group consisting of tetramethylammonium hydroxide, ammonium hydroxide, potassium hydroxide, sodium hydroxide, potassium carbonate and the mixtures thereof.

12. The process as claimed in Claim 9,

wherein the oxidizing agent is hydrogen peroxide and the alkaline component is selected from the group consisting of tetramethylammonium hydroxide, ammonium hydroxide, potassium hydroxide, sodium hydroxide, potassium carbonate and the mixtures thereof.

13. Process according to claim 14, comprising

flushing the treatment agent solution off the semiconductor water by using deionized water, after completing the

oxidizing.

14. Process for treating a semiconductor wafer, comprising
polishing the semiconductor wafer;
immediately after polishing the semiconductor wafer
removing the semiconductor wafer from a polishing plate;
immediately after removing the semiconductor wafer from
the polishing plate, bringing the semiconductor wafer into contact
with an aqueous treatment agent solution for oxidizing a polished
surface of the semiconductor wafer by action of the aqueous
treatment agent solution,
the wafer being brought into contact with the aqueous
treatment agent solution in a manner which is selected from the
group consisting of (a) spraying the semiconductor wafer with the
aqueous treatment agent solution, (b) dipping the semiconductor
wafer into the aqueous treatment agent solution and (c) applying
the aqueous treatment solution to the polished surface of the
semiconductor wafer by means of a cloth which has been moistened
with the aqueous treatment agent solution; and
cleaning the semiconductor wafer.

15. The process as claimed in Claim 14, comprising
storing the semiconductor wafer in deionized water after
contact with the aqueous treatment agent solution.

16. The process according to claim 14, comprising
bringing the semiconductor wafer into contact with the
aqueous treatment agent solution containing an oxidizing agent and
an alkaline component.

17. Process for treating a semiconductor wafer,
comprising

polishing the semiconductor wafer;

immediately after polishing the semiconductor wafer
removing the semiconductor wafer from a polishing plate;

immediately after removing the semiconductor wafer from
the polishing plate, bringing the semiconductor wafer into contact
with an aqueous treatment agent solution for oxidizing a polished
surface of the semiconductor wafer by action of the aqueous
treatment agent solution,

the wafer being brought into contact with the aqueous
treatment agent solution in a manner which is selected from the
group consisting of (a) spraying the semiconductor wafer with the
aqueous treatment agent solution, (b) dipping the semiconductor
wafer into the aqueous treatment agent solution and (c) applying
the aqueous treatment solution to the polished surface of the
semiconductor wafer by means of a cloth which has been moistened
with the aqueous treatment agent solution;

flushing the treatment agent solution off the
semiconductor wafer by using deionized water, after completing the

oxidizing; and

cleaning the semiconductor wafer.

18. Process for treating a semiconductor wafer,
comprising

polishing the semiconductor wafer;

immediately after polishing the semiconductor wafer
removing the semiconductor wafer from a polishing plate;

immediately after removing the semiconductor wafer from
the polishing plate, bringing the semiconductor wafer into contact
with an aqueous treatment agent solution for oxidizing a polished
surface of the semiconductor wafer by action of the aqueous
treatment agent solution,

the wafer being brought into contact with the aqueous
treatment agent solution in a manner which is selected from the
group consisting of (a) spraying the semiconductor wafer with the
aqueous treatment agent solution, (b) dipping the semiconductor
wafer into the aqueous treatment agent solution and (c) applying
the aqueous treatment agent solution to the polished surface of the
semiconductor wafer by means of a cloth which has been moistened
with the aqueous treatment agent solution;

wherein the aqueous treatment agent solution comprises an
aqueous solution of

- (1) from 0.02% to 3.0% by volume, based upon the total
solution volume, of an oxidizing agent which is hydrogen

peroxide;

- (2) from 0.01% to 2.0% by weight, based upon the total solution weight, of an alkaline component; and
- (3) the balance up to 100% by volume being water based upon the total solution volume, and the balance up to 100% by weight being water, which is based upon the total solution weight.

wherein the alkaline component is selected from the group consisting of tetramethylammonium hydroxide, ammonium hydroxide, potassium hydroxide, sodium hydroxide, potassium carbonate and the mixtures thereof; and

cleaning the semiconductor wafer.

19. Process according to claim 17, further comprising storing the semiconductor wafer for at least 15 minutes in deionized water after contact with the aqueous treatment agent solution, before said cleaning of the semiconductor wafer.

20. Process according to claim 18, further comprising flushing the treatment agent solution off the semiconductor wafer by using deionized water, after completing the oxidizing; and

storing the semiconductor wafer for at least 15 minutes in deionized water after contact with the aqueous treatment agent solution, before said cleaning of the semiconductor wafer.